South Carolina
Department of Health and Environmental Control

Total Maximum Daily Load Development for the Rocky River Watershed and Wilson Creek (Hydrologic Unit Code: 03060103 - 070 and - 080); Stations: SV-031, SV-041, SV-043, SV-139, SV-140, SV-141, and SV-347 Fecal Coliform Bacteria

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PROMOTE PROTECT PROSPER
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Abstract

The Rocky River watershed and Wilson Creek (11-digit HUCs 03060103 – 070 and – 080 respectively) are located in the Savannah River Basin in western South Carolina (Anderson and Abbeville counties) in the Piedmont region (Figure 1-1). Six water quality monitoring stations in the Rocky River watershed and one on Wilson Creek have been placed on the South Carolina §303(d) list of impaired waters for violations of the fecal coliform bacteria standard, as shown in Table 1-1. The 233 square mile watershed is composed of mostly forest (56%) with some pastureland (22%) and cropland (14%). The basin includes several areas that have been designated as Municipal Separate Storm Sewer Systems (MS4). There are also three active continuous point sources discharging fecal coliform bacteria in the Rocky River watershed and one discharging into Wilson Creek.

The load-duration curve methodology was used to establish allowable fecal coliform bacteria loads in the watershed. The existing load was determined using measured data from the impaired water quality monitoring stations. Loads were established from measured concentrations and a power trend line was fit to samples violating the instantaneous standard. The existing load and allowable total maximum daily load (TMDL) for impaired stations is presented in Table I. To achieve the TMDL target, reductions of fecal coliform bacteria loads will be necessary, as shown in Table I.

Table I Total Maximum Daily Loads for Impaired Water Quality Stations in the Rocky River Watershed and Wilson Creek (03060103-070 and -080)

Station ID	Existing Waste Load	TMDL WLA		Existing Load	TMDL LA	MOS	TMDL[3]	Percent Reduction[4]
	Continuous (counts/day)	Continuous[1] (counts/day)	MS4[2]	(counts/day)	(counts/day)	(counts/day)	(counts/day)	
SV-031	NA	NA	50%	1.08E+12	5.10E+11	2.84E+10	5.39E+11	50%
SV-041	9.24E+10	9.24E+10	83%	3.37E+12	4.59E+11	3.06E+10	5.82E+11	83%
SV-043	NA	NA	76%	3.51E+11	7.83E+10	4.35E+09	8.26E+10	76%
SV-139	NA	NA	93%	2.21E+11	1.54E+10	8.53E+08	1.62E+10	93%
SV-140	NA	NA	74%	1.02E+11	2.51E+10	1.39E+09	2.65E+10	74%
SV-141	NA	NA	55%	8.17E+11	3.46E+11	1.92E+10	3.65E+11	55%
SV-347	NA	NA	22%	4.79E+11	3.55E+11	1.97E+10	3.75E+11	22%

Table Notes:

1. Total monthly wasteload (#/30day) cannot exceed loads listed in Table 3-3.
2. MS4 expressed as percent reduction equal to LA reduction.
3. TMDLs expressed as monthly load (#/30day) by station are listed in Table B-1.
4. Percent reduction applies to LA and MS4 components when an MS4 is in the watershed.

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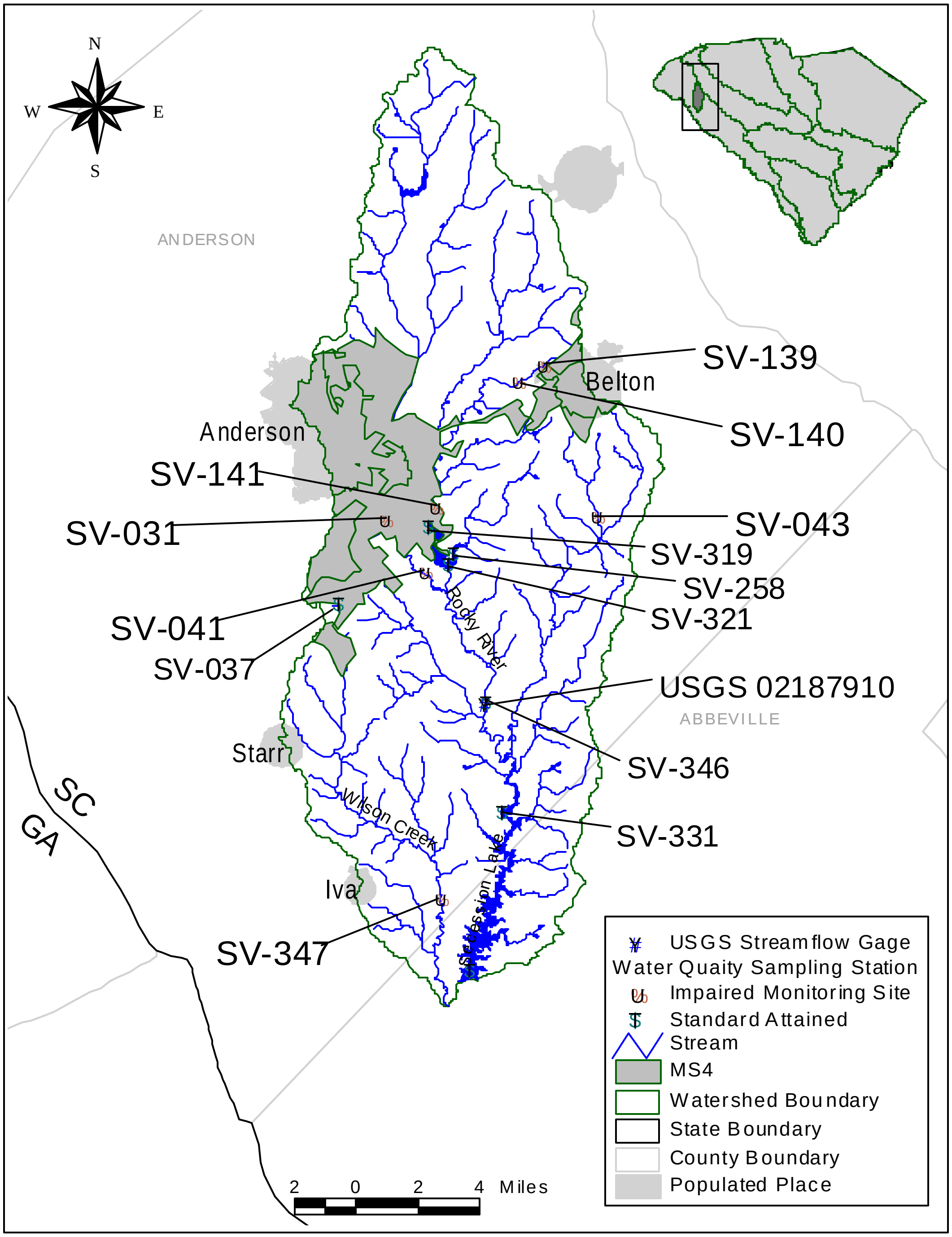

Figure 1-1 Rocky River Watershed and Wilson Creek (03060103-070 and -080)

1.0 INTRODUCTION

1.1 Background

Levels of fecal coliform bacteria can be elevated in waterbodies as the result of both point and nonpoint sources of pollution. Section §303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for waterbodies that are not meeting designated uses under technology-based pollution controls. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and instream water quality conditions so that states can establish water quality-based controls to reduce pollution and restore and maintain the quality of water resources (USEPA, 1991).

The State of South Carolina has placed six monitoring stations in the Rocky River watershed (11-digit HUC 03060103-070) and one monitoring station on Wilson Creek (11-digit HUC 03060103-080) on South Carolina's 2002 Section §303(d) list for impairment due to fecal coliform bacteria. These stations are identified in Table 1-1.

Table 1-1 Water Quality Monitoring Stations Impaired by Fecal Coliform in the Rocky River Watershed and on Wilson Creek (03060103-070 and -080)

Waterbody Name	Waterbody ID	Waterbody Location
Rocky River	SV-031	Rocky River at S-04-263 2.7 miles SE of Anderson at STP
Rocky River	SV-041	Rocky River at S-04-152 below Rocky River STP
Cherokee Creek	SV-043	Cherokee Creek at S-04-318 4 miles S of Belton
Cupboard Creek	SV-139	Cupboard Creek at S-04-733 above Breazeale STP and below Blair Hill
Cupboard Creek	SV-140	Cupboard Creek at S-04-209 below Effluent from Belton 2 Plant
Broadway Creek	SV-141	Broadway Creek at US 76 between Anderson and Belton
Wilson Creek	SV-347	Wilson Creek at S-04-294

1.2 Watershed Description

The Rocky River and Wilson Creek watersheds (11-digit HUC 03060103-070 and -080) (Figure 1-1) are located in the Savannah River basin in Anderson County with a small portion of the lower watershed extending into Abbeville County. The Rocky River flows 38 miles through the City Anderson and is joined by Broadway, Beaver and Hencoop Creek's before discharging into Secession Lake. The entirety of the Rocky River watershed (11-digit HUC 03060103-070) drains 195 square miles. The 38 square mile Wilson Creek watershed (11-digit HUC 03060103-080) parallels Rocky River near its confluence with Secession Lake, flowing through the Cities of Starr and Iva.

Based on 1996 USGS Multi-Resolution Land Characteristic (MRLC) land use data, 56 percent of the watershed is forested. The remaining 44 percent is composed of pastureland (22%), cropland (13%), urban area (7%), and a small mix of water and barren land uses (2%). Table 1-2 presents the percentage of total watershed area for each aggregated land use. Table A-1 (Appendix A) presents the percentage of land use area in each monitoring station and USGS streamflow station drainage area. The areas are also represented in miles squared in Table A-2. Figure 1-2 illustrates land use for the Rocky River watershed and Wilson Creek.

Table 1-2 MRLC Aggregated Land Use for the Rocky River Watershed and Wilson Creek (03060103-070 and -080)

Aggregated Land Use	Percent of Total Area	Total Area (miles^2)
Urban	6.6%	15.5
Barren	0.7%	1.7
Row Crops	13.6%	31.6
Pasture	21.8%	50.7
Forest	56.1%	131
Water	1.2%	2.7

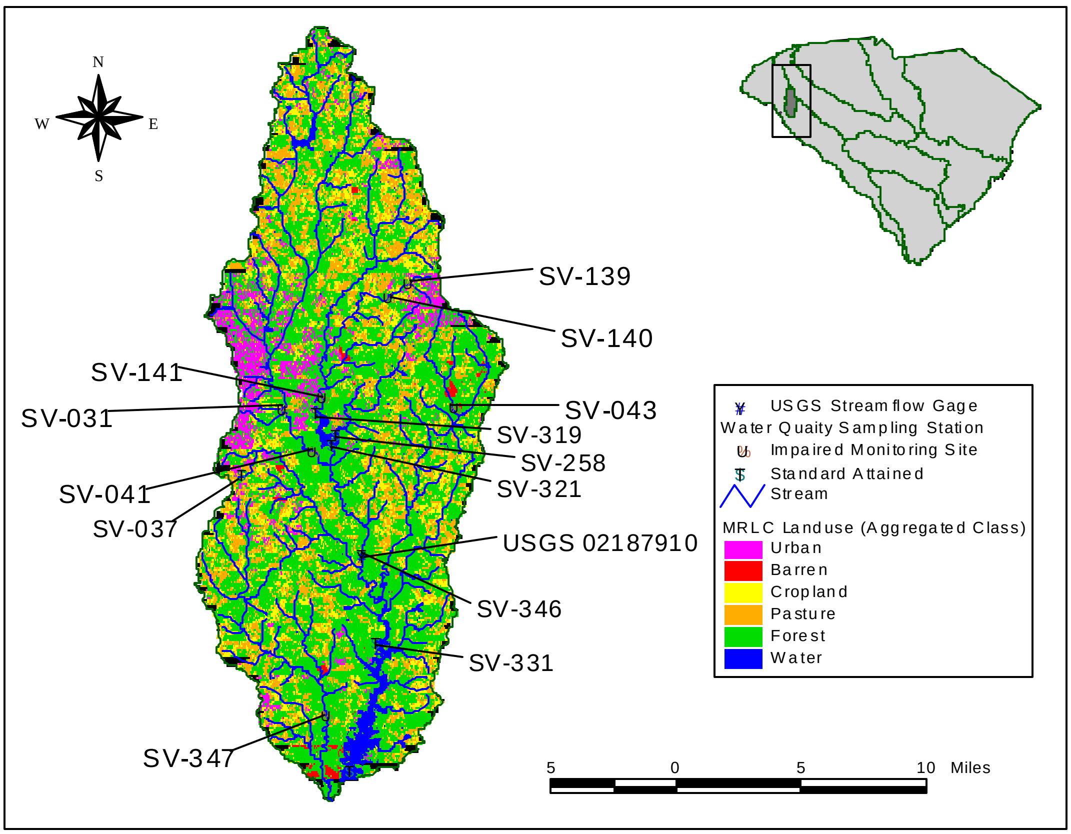

Figure 1-2 Rocky River Watershed and Wilson Creek Land Use

1.3 Water Quality Standard

The impaired stream segments of the Rocky River watershed and Wilson Creek are designated as Class Freshwater. Waters of this class are described as:

> "Freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the Department. Suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. Suitable also for industrial and agricultural uses." (R.61-68)

South Carolina's standard for fecal coliform bacteria in freshwater is:

> "Not to exceed a geometric mean of 200/100 mL, based on five consecutive samples during any 30 day period; nor shall more than 10 percent of the total samples during any 30 day period exceed 400/100 mL." (R.61-68).

2.0 WATER QUALITY ASSESSMENT

Fecal coliform bacteria data collected in the Rocky River watershed and on Wilson Creek from 1990 through 2001 were assessed to determine impairment of standards for recreational use. The State of South Carolina monitors fecal coliform bacteria at 14 stations in the watershed, as shown in Figure 1-1.

Seven water quality monitoring stations in the basin have been identified on the State of South Carolina's Section §303(d) list for 2002 as impaired (Table 1-1). Table 2-1 presents statistical information supporting the listing of impaired water quality monitoring sites in the watershed. Waters in which no more than 10 percent of the samples collected over a five year period are greater than 400 fecal coliform counts per 100 mL are considered to comply with the South Carolina water quality standard for fecal coliform bacteria. Waters with more than 10 percent of samples greater than 400 counts per 100 mL are considered impaired and were listed for fecal coliform bacteria on the State of South Carolina's Section §303(d) list. The fecal coliform bacteria data collected at impaired water quality monitoring stations is presented in Table A-2 of Appendix A.

Table 2-1 Statistical Assessment of Observed Fecal Coliform Bacteria Collected from 1996 - 2000

Station	Total Number of Samples	Total Number of Samples >400 #/100 mL	Percent of Samples >400 #/100 mL
SV-031	58	17	29%
SV-041	40	10	25%
SV-043	28	12	43%
SV-139	28	15	54%
SV-140	28	17	61%
SV-141	30	8	27%
SV-347	24	5	21%

The timeframe, both annually and seasonally, of water quality monitoring at each station varies greatly. The statistical assessment presented in Table 2-1 was based on data collected over the five-year period from 1996 through 2000.

After determining compliance with water quality standards, observed violations were assessed to determine conditions critical to impairment. Data were compared with estimated streamflows to establish a relationship between instream concentrations and hydrologic conditions. Due to limited streamflow data in the watershed, observed data were plotted with the load-duration curves generated based on area-weighted flows. The development of load-duration curves is discussed further in Section 4.0 of this report. Load-duration curves plotted for each station in Figures B-1 through B-6, and in Figure 2-1 (for SV-031) are equal to the TMDL target based on the criteria for instantaneous events. The observed fecal coliform bacteria data were also converted from counts per 100 mL to loads in counts per day to assess hydrologic conditions when the standard is not attained.

The percent of flow exceeded in Figure 2-1 and Figures B-1 through B-6 represent flow conditions at each monitoring station. Hydrologic conditions for very dry events, likely to be exceeded in 99.99 percent of measured events, are represented as 99.99 percent. Extremely wet events that occur rarely are represented as 0.01 percent. Data collected at all impaired stations in the basin have violations during all flow conditions. Violations during various flow events suggest both overland, instream, and continuous sources, such as groundwater, of fecal coliform bacteria.

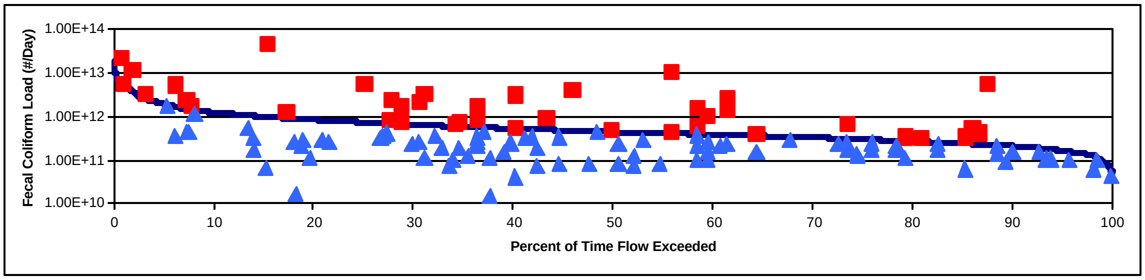

Figure 2-1 Fecal Coliform Bacteria Load-Duration Curve for Station SV-031 Illustrating Observed Fecal Coliform Bacteria Loads Over Various Hydrologic Conditions

3.0 SOURCE ASSESSMENT AND LOAD ALLOCATION

Fecal coliform bacteria enter surface waters of the Rocky River watershed and Wilson Creek from both point and nonpoint sources. Urban areas permitted under the NPDES program as Municipal Separate Storm Sewer Systems (MS4s) and facilities that discharge at a specific location through pipes, outfalls, and/or conveyance channels are point source discharges. Nonpoint sources are diffuse sources that have multiple routes of entry into surface waters. Some nonpoint sources are related to land use activities that accumulate fecal coliform bacteria on the land surface (i.e. pastureland) and runoff during storm events.

3.1 Point Sources

There are three active continuous point sources discharging fecal coliform bacteria in the Rocky River watershed and one discharging in to Wilson Creek. Several urbanized areas have been designated as MS4s.

3.1.1 Continuous Point Sources

Of the facilities in the watershed, only one, Anderson/Rocky River WWTF (SC0023744), is discharging into the drainage area of an impaired water quality monitoring station (SV-041). Facilities with continuous discharges of fecal coliform bacteria are listed in Table 3-1 and illustrated in Figure 3-1. In South Carolina, NPDES permittees that discharge sanitary wastewater must meet the State criteria for fecal coliform bacteria at the point of discharge (i.e. a daily maximum concentration of 400 counts per 100 mL, and a 30-day geometric mean of 200 counts per 100 mL).

Table 3-1 Permitted Facilities Discharging Fecal Coliform Bacteria into Waterbodies of the Rocky River Watershed and Wilson Creek

Facility Name	NPDES No.	Flow Limits * (MGD)	Receiving Stream
Owens Corning/Anderson Plant	SC0000400	0.22	Betsy Creek at Rocky River
Anderson/Rocky River STP	SC0023744	6.1	Rocky River
Eastside WWTF	SC0025810	0.245	East Beard Creek
Mayfair Mills/Starr Mill	SC0037443	INACTIVE 02/05/2003	Unnamed Tributary to Wilson Creek to Rocky River
Former Eliskim RCRA Post Closure	SC0047210	0.08	Beaver Creek

* Note: Flow limits are either permit limits or design limits.

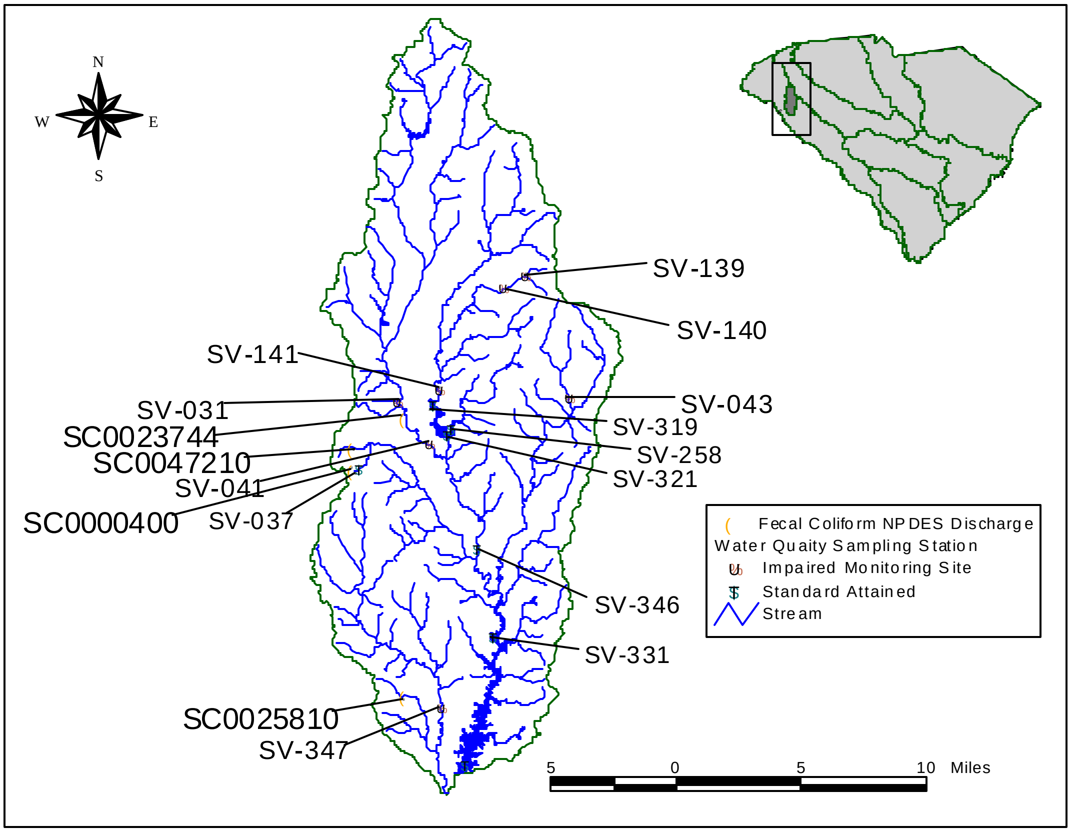

Figure 3-1 Active Fecal Coliform Bacteria Discharging NPDES Facilities

The TMDL presented in this report for SV-041 was developed using permitted flow for the Anderson/Rocky River STP (SC0023744) and permitted concentrations for fecal coliform bacteria. Estimated existing loads calculated for the permitted geometric mean concentration of 200 counts per 100 mL and instantaneous concentration of 400 counts per 100 mL for NPDES facility SC0023744 are listed in Table 3-2.

In addition to the wastewater treatment facilities, collection systems may contribute fecal coliform bacteria to streams. Sewage collection systems typically are placed adjacent to waterways. At these locations, there is a potential for collection system leaks which could result in elevated instream concentrations of fecal coliform bacteria. Sanitary sewer overflows (SSOs) are also a potential source, particularly after periods of intense rainfall. This source is associated with infrequent events, limited in duration and likely to have an insignificant long-term impact instream. Identified collection system and/or SSO problems are addressed by SCDHEC through compliance and enforcement mechanisms. Cupboard Creek in Belton and Rocky River in Anderson have adjacent sanitary sewer lines.

Table 3-2 Estimated Existing Fecal Coliform Bacteria Loads for NPDES Facility SC0023744 Discharging into the Drainage Area of Impaired Water Quality Monitoring Station SV-041, Rocky River at S-04-152 below Rocky River STP

NPDES Facility	Flow (MGD)	Existing Loading (counts/days)	Existing Loading (counts/30days)
SC0023744	6.1	9.24E+10	1.39E+12

3.1.2 Municipal Separate Storm Systems (NPDES)

The Cities of Anderson and Belton and unincorporated Anderson County in the Rocky River and Wilson Creek watersheds (Figure 1-1) have or will have NPDES MS4 (Municipal Separate Storm Sewer System) permits. These permitted sewer systems will be treated as point sources in the TMDL calculations below. However for modeling purposes all urban areas will be evaluated together as urban nonpoint sources.

In 1990, EPA developed rules establishing Phase I of the National Pollutant Discharge Elimination System (NPDES) storm water program, designed to prevent harmful pollutants from being washed by storm water runoff into Municipal Separate Storm Sewer Systems (MS4s) (or from being dumped directly into the MS4) and then discharged into local waterbodies (SCDHEC, 2002). Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or greater) to implement a storm water management program as a means to control polluted discharges from MS4s. Approved storm water management programs for medium and large MS4s are required to address a variety of water quality related issues including roadway runoff management, municipal owned operations, and hazardous waste treatment.

Phase II of the rule extends coverage of the NPDES storm water program to certain small MS4s. Small MS4s are defined as any MS4 that is not a medium or large MS4 covered by Phase I of the NPDES Storm Water Program. Phase II requires operators of regulated small MS4s to obtain NPDES permits and develop a storm water management program. Programs are to be designed to reduce discharges of pollutants to the "maximum extent practicable”, protect water quality, and satisfy appropriate water quality requirements of the Clean Water Act.

3.2 Nonpoint Sources

The land use distribution of the Rocky River watershed and Wilson Creek provide insight into determining nonpoint sources of fecal coliform bacteria (Figure 1-2). In the watershed, 56 percent of the land area is classified forested, 22 percent is pastureland, and 14 percent of the area is cropland. Key nonpoint sources identified in the watershed include livestock, manure application, failing septic systems, illicit discharges (including leaking and overflowing sewers), and natural sources.

3.2.1 Wildlife

Fecal coliform bacteria are found in forested areas, pastureland, and cropland due to the presence of wild animal sources such as deer, raccoons, wild turkeys and waterfowl. The Department of Natural Resources in South Carolina estimates the deer habitat in the basin at a density of 15 to 30 deer per square mile in the headwaters to 45 deer per square mile in the central and lower portion of the watershed (SC Deer Density 2000 map). Deer habitat was assumed to include forests, cropland, and pastures. Wildlife waste is transported over land surfaces during rainfall events or may be directly deposited by animals into streams. The high percentage of permeable surfaces in forested areas increases the infiltration rate over the watershed area. This process ultimately reduces the runoff reaching streams by overland flow and reduces the significance of fecal coliform bacteria contributions transported over land.

3.2.2 Agricultural Activities and Grazing Animals

Agricultural land can be a source of fecal coliform bacteria. Runoff from grazing pastures, improper land application of animal wastes, livestock operations, and livestock with access to waterbodies are all agricultural sources of fecal coliform bacteria. Agricultural best management practices (BMPs) such as buffer strips, alternative watering sources, limiting livestock access to streams, and the proper land application of animal wastes reduce fecal coliform bacteria loading to waterbodies.

The number of animals in the watershed, shown in Table 3-3, was estimated by area-weighting the 1997 USDA census data over the pastureland in the watershed for Anderson and Abbeville Counties. Census data show that grazing cattle are of more relevance in the Rocky River and Wilson Creek watersheds than confined animal operations. Livestock, except for dairy cattle, are not usually confined and are typically grazing in the pastures where deposited manure is a source of nonpoint pollution. The time that cattle spend in streams is assumed to be 0.15 percent of their total gazing time. Hogs are anticipated to be generally confined, where as sheep are expected to spend all of their time grazing. Horses and ponies are expected to spend the majority of spring, summer, and fall months grazing in pastureland where manure is a source of nonpoint pollution.

Table 3-3 1997 USDA Agricultural Census Data Animal Estimates

Animal	1997 Census Estimate
Beef Cow	6,125
Dairy Cow	505
Hog	490
Sheep	61
Horses and Ponies	489

3.2.3 Failing Septic Systems and Illicit Discharges

Failing septic systems and illegal discharges represent a nonpoint source that can contribute fecal coliform to receiving waterbodies through surface, subsurface malfunctions or direct discharges. Based on 1990 census information, population change from 1990 and 2000, and assuming an average of 2.5 people per household (U.S. Census, 2000), nearly 27,000 people in the Rocky River and Wilson Creek watersheds use septic systems. Though the precise failure rate is unknown, Schueler (1999) suggests an average septic failure rate of 20 percent. Impaired water quality monitoring stations in MS4 permitted areas may also receive fecal coliform bacteria from leaking and/or overflowing sewer systems during rain events. These illicit discharges contribute significant loads of fecal coliform bacteria directly to streams.

3.2.3 Urban Runoff

Runoff from urban areas not permitted under the Municipal Separate Storm System (MS4) program may be a significant source of fecal coliform bacteria in the Rocky River watershed. Water quality data collected from Cupboard Creek draining the town of Belton show existing instream loads of fecal coliform bacteria violating the State's instantaneous standards in greater than 50 percent of samples. Best management practices such as buffer strips and the proper disposal of domestic animal wastes reduce fecal coliform bacteria loading to waterbodies.

4.0 TECHNICAL APPROACH – LOAD-DURATION METHOD

Load-duration curves were developed for water quality stations in the Rocky River watershed and on Wilson Creek to establish allowable fecal coliform bacteria loads under various hydrologic conditions. The load-duration methodology uses the cumulative frequency distribution of streamflow and pollutant concentration (fecal coliform bacteria) data to estimate the allowable loads for a waterbody. Allowable load-duration curves were established in the basin using the instantaneous concentration of fecal coliform bacteria, minus a five percent margin of safety (MOS), and streamflow measured at various USGS stations in the watershed and surrounding watersheds, as shown in Figure 4-1 and listed in Table 4-1.

Table 4-1 USGS Stations Used to Establish Area-Weighted Flows

Site Number	Site Name	From	To	Drainage Area (mile2)
02187910	Rocky River near Starr, SC	5/25/1989	9/30/2001	91.7
02156050	Lawson Fork Creek at Dewey Plant near Inman, SC	10/1/1979	9/30/2001	6.46
02154790	South Pacolet River near Campobello, SC	1/6/1989	9/30/2001	55.4

Table 4-2 USGS Stations and Associated Water Quality Stations

USGS Gage	Waterbody ID	Waterbody Name
02187910	SV-031	Rocky River
	SV-041	Rocky River
	SV-141	Broadway Creek
02156050	SV-139	Cupboard Creek
	SV-140	Cupboard Creek
02154790	SV-043	Cherokee Creek
	SV-347	Wilson Creek

Streamflow data was not available at each impaired water quality monitoring station to develop load-duration curves. Therefore, flows were determined by area-weighted data collected at USGS stations listed in Table 4-1. Data collected at these stations through 2001 were used in the analysis.

Watershed characteristics (including the total drainage area, distribution of land use activities, ecoregion, and topography) for the USGS stations and impaired water quality monitoring sites were compared to associate stations to develop load-duration curves. Table 4-2 lists the impaired water quality monitoring stations and associated streamflow stations used to develop area-weighted flow relationships.

Ideally streamflow available in the watershed would be used to establish loads for TMDLs but for some stations in the Rocky River watershed that was not appropriate and two USGS gages outside the watershed were used. The selection of the USGS station

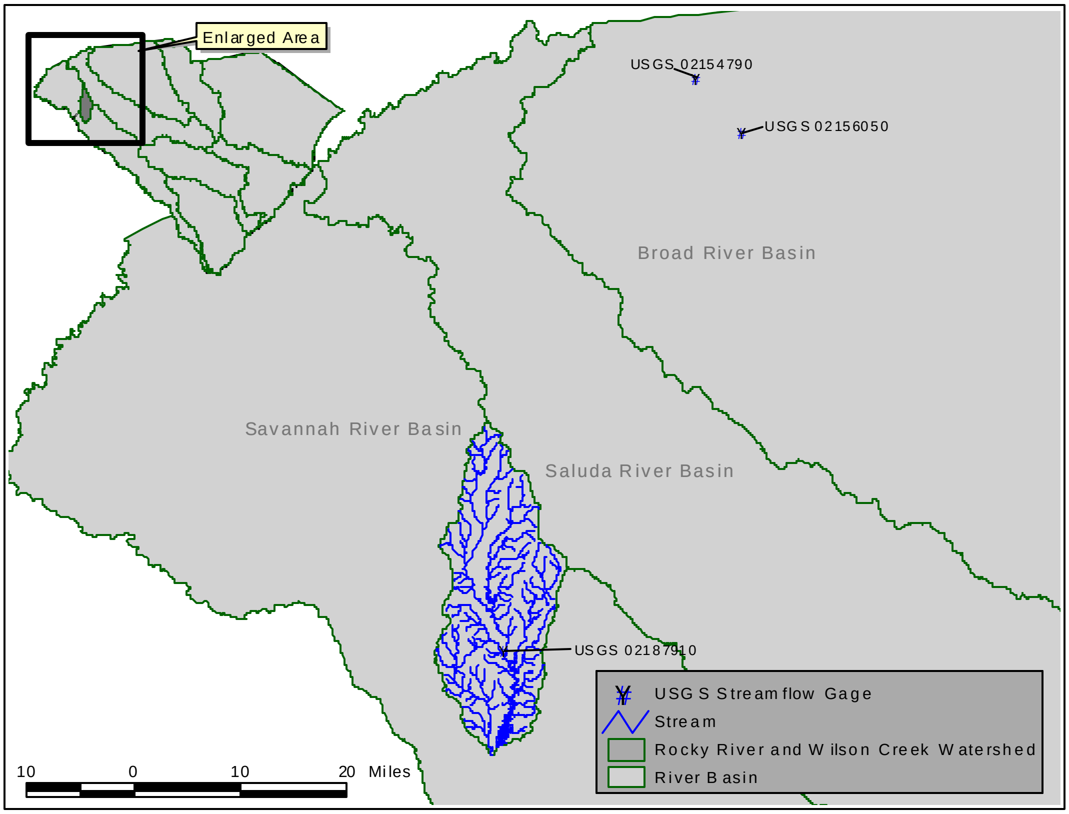

Figure 4-1 USGS Monitoring Stations Used in TMDL Development

02156050 for use in the development of load-duration curves for SV-139 and SV-140 was made based on several factors. USGS 02156050 is located on Lawson's Creek at Dewey Plant near Inman in the upper Broad River basin and drains a 6.46 square mile area. The majority of the watershed is within MS4 areas for unincorporated Spartanburg County and the City of Inman though the intensity of urban activities is not reflected in the land use distribution in Tables A-1 and A-2. In addition to having an extensive dataset and small watershed area within an MS4, the watershed is also located within the Piedmont region of the state. These factors made USGS 02156050 the most appropriate streamflow station to use in developing load-duration curves for SV-139 and SV-140, stations located on Cupboard Creek in the City of Belton. It should be noted, that a small municipal plant permitted to discharge 0.175 MGD (million gallons per day) or less than 0.3 cfs (cubic feet per second) for the City of Inman, is located upstream of USGS 02156050. It is believed that the contributions from this facility are negligible given other assumptions made in the development of these load-duration curves. The decision to use USGS 02154790, South Pacolet River near Campobello also in the upper Broad River basin, is supported through the land use distribution in Tables A-1 and A-2 and drainage area.

The locations of USGS stations are identified in Figure 4-1. Figure 4-2 illustrates the water yield for impaired station SV-031 associated with USGS station 02187910, located on Rocky River near Starr, SC. Water yields associated with other USGS streamflow gages are presented in Figures B-7 and B-8 of Appendix B.

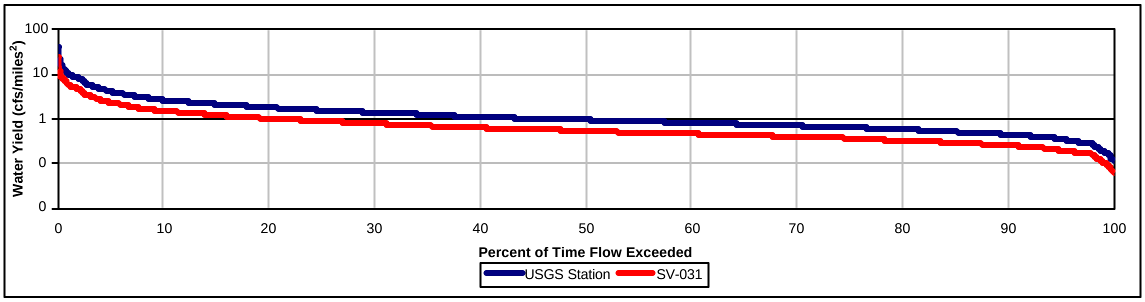

Figure 4-2 Water Yield (cubic feet per second per square mile) for SV-031 Based on Measured Daily Streamflow from USGS station 02187910

After calculating streamflow for each impaired monitoring station the data were ranked to determine the percent of time streamflow was exceeded. The streamflow was then multiplied by a concentration of 380 counts/100 mL (based on the instantaneous concentration and a five percent MOS) to generate a load-duration curve for each impaired station, shown in Figures B-1 through B-6 of Appendix B. The result of the load-duration curve is the TMDL target.

To define the TMDL for each station, an average of the load-duration curve was calculated. The average was calculated using loads at five percent intervals from the 10th percentile of flow exceeded to the 90th percentile of flow exceeded. Loads occurring at less than the 10th percentile of flow exceeded are extreme high flow events and the data collected at greater than the 90th percentile of flow exceeded are extreme low flow events and therefore were not considered in developing theses TMDLs. Loads established at intervals and the TMDL target load for each station can be found in Appendix B, Table B-1.

5.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

A total maximum daily load (TMDL) for a given pollutant and waterbody is comprised of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for both nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is represented by the equation:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

The TMDL is the total amount of a pollutant that can be assimilated by the receiving waterbody while still achieving water quality standards. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established and thereby provide the basis to establish water quality-based controls. For some pollutants, TMDLs are expressed on a mass-loading basis (e.g., pounds per day). For bacteria, however, TMDLs can be expressed in terms of organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l).

5.1 Critical Conditions

Critical conditions for fecal coliform bacteria in the Rocky River and Wilson Creek watersheds occur at various flow regimes. The load-duration curve methodology used to establish TMDLs in the watershed considers various hydrologic conditions critical in maintaining water quality standards.

5.2 Existing Load

The existing load for each impaired station was established using observed fecal coliform bacteria data and area-weighted streamflow. The measured data occurring at less than the 10^{th} percentile of flow exceeded is an extreme high flow event and the data collected at greater than the 90^{th} percentile of flow exceeded is an extreme low flow event and therefore not considered as critical conditions for these TMDLs.

The data violating the instantaneous concentration were isolated and a best-fit trendline was fit to violating data. The power trendline was determined using a best-fit relationship that was most representative of the violating data. The equation representing the trendline was then used to calculate the average violating load that occurred between the 10^{th} and 90^{th} percentiles, at every fifth percentile. This average load is equal to the existing instream fecal coliform bacteria load at the associated station. The existing load from nonpoint sources is then equal to the existing instream load minus the existing wasteload from point sources.

Figure 5-1 presents the power best-fit trendline for station SV-031, an impaired station on Rocky River. Interval loads calculated for existing instream conditions at each station are presented in Table B-2. Power trendlines are presented in Figures B-1 through B-6 of Appendix B. Existing loads from nonpoint sources calculated for each station are listed in Table 5-1.

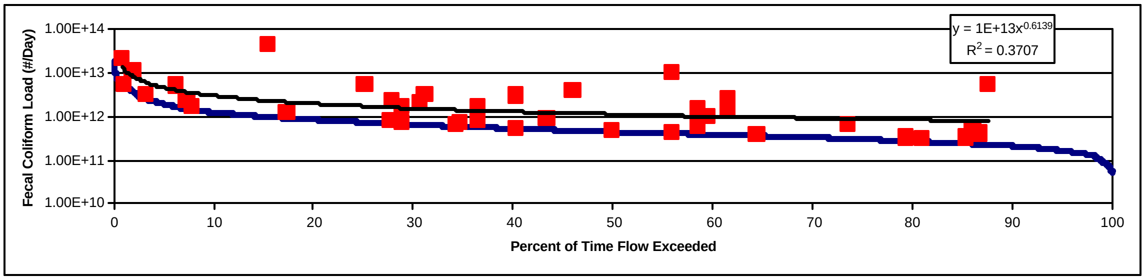

Figure 5-1 Power Trendline Generated from Violating Fecal Coliform Bacteria Measured at SV-031

Table 5-1 Existing Loads for Impaired Water Quality Stations in the Rocky River Watershed and on Wilson Creek (03060103-070 and -080)

Station ID	Existing Load (counts/day)
SV-031	1.08E+12
SV-041	3.37E+12
SV-043	3.51E+11
SV-139	2.21E+11
SV-140	1.02E+11
SV-141	8.17E+11
SV-347	4.79E+11

5.3 Existing Wasteload

The existing wasteload was calculated for each NPDES permitted continuous discharge. The facilities were assumed to discharge at permitted flows, or design flows when a flow limit was not designated in the permit, and permitted limits of fecal coliform bacteria equal to the State criteria for both instantaneous and geometric mean loads. In South Carolina, NPDES permittees that discharge sanitary wastewater must meet the State's criteria for fecal coliform bacteria at the point of discharge (i.e. a daily maximum concentration of 400 counts per 100 mL, and a 30-day geometric mean of 200 counts per 100 mL). Under these permitted concentrations facilities should not be in exceedance of the fecal coliform bacteria water quality criteria, and therefore, not considered to be a major contributing source. If facilities are discharging at greater than permitted concentrations this is an illicit discharge and regulated through the NPDES program. Allowable TMDL wasteloads for impaired stations, as shown in Table 5-2, are equal to loads calculated for facilities in the watershed.

Table 5-2 Wasteload from the NPDES Continuous Discharge to Impaired Water Quality Stations in the Rocky River Watershed (03060103-070)

Station ID	Existing Waste Load Continuous (counts/day)
SV-041	9.24E+10

5.4 Margin of Safety

There are two methods for incorporating a margin of safety (MOS) in the analysis: a) by implicitly incorporating the MOS using conservative assumptions to develop allocations; or b) by explicitly specifying a portion of the TMDL as the MOS and using the remainder for allocations. For the Rocky River watershed and Wilson Creek TMDLs, both methods were applied to incorporate a MOS. An implicit MOS was incorporated through the use of conservative assumptions in developing the TMDL, such as the use of the design or permitted flow for NPDES facilities and the use of a trendline to establish a total instream load. A five percent explicit MOS was reserved from the water quality criteria in developing the load-duration curves. Specifically, the water quality target was set at 190 counts per 100 mL for the geometric mean 30-day period and 380 counts per 100 mL for the instantaneous criterion, which is five percent lower than the water quality criteria of 200 and 400 counts per 100 mL, respectively.

5.5 Total Maximum Daily Load

The TMDL represents the maximum fecal coliform bacteria load the stream may carry and still meet water quality standards. The TMDL is presented in fecal coliform counts to be protective of both the instantaneous, per day, and geometric mean, per 30-day, criteria. Table 5-3 defines the fecal coliform bacteria total maximum daily load for protection of water quality standards for impaired stations in the Rocky River watershed and on Wilson Creek.

There are three municipalities in the watershed that have or will have NPDES MS4 permits. The Cities of Anderson and Belton and Anderson County will eventually be covered under one or more NPDES phase II stormwater permits. The reduction percentages in this TMDL apply also to the fecal coliform waste load attributable to those areas of the watershed which are covered or will be covered under NPDES MS4 (Municipal Separate Storm Sewer System) permits. Compliance by these municipalities with the terms of their individual MS4 permits will fulfill any obligations they have towards implementing this TMDL

Table 5-3 Total Maximum Daily Loads for Impaired Water Quality Stations in the Rocky River Watershed and Wilson Creek (03060103-070 and -080)

Station ID	Existing Waste Load	TMDL WLA		Existing Load	TMDL LA	MOS	TMDL[3]	Percent Re-duction[4]
	Continuous (counts/ day)	Continuous[1] (counts/ day)	MS4[2]	(counts/day)	(counts/day)	(counts/day)	(counts/day)	
SV-031	NA	NA	50%	1.08E+12	5.10E+11	2.84E+10	5.39E+11	50%
SV-041	9.24E+10	9.24E+10	83%	3.37E+12	4.59E+11	3.06E+10	5.82E+11	83%
SV-043	NA	NA	76%	3.51E+11	7.83E+10	4.35E+09	8.26E+10	76%
SV-139	NA	NA	93%	2.21E+11	1.54E+10	8.53E+08	1.62E+10	93%
SV-140	NA	NA	74%	1.02E+11	2.51E+10	1.39E+09	2.65E+10	74%
SV-141	NA	NA	55%	8.17E+11	3.46E+11	1.92E+10	3.65E+11	55%
SV-347	NA	NA	22%	4.79E+11	3.55E+11	1.97E+10	3.75E+11	22%

Table Notes:

1. Total monthly wasteload (#/30day) cannot exceed loads listed in Table 3-3.
2. MS4 expressed as percent reduction equal to LA reduction.
3. TMDLs expressed as monthly load (#/30day) by station are listed in Table B-1.
4. Percent reduction applies to LA and MS4 components when an MS4 is in the watershed.

6.0 IMPLEMENTATION

As discussed in the *Implementation Plan for Achieving Total Maximum Daily Load Reductions From Nonpoint Sources for the State of South Carolina* (SCDHEC,1998), South Carolina has several tools available for implementing this nonpoint source TMDL. Specifically, SCDHEC's animal agriculture permitting program addresses animal operations and land application of animal wastes. In addition, SCDHEC will work with the existing agencies in the area to provide nonpoint source education in the Rocky River watershed. Local sources of nonpoint source education and assistance include Clemson Extension Service, the Natural Resource Conservation Service (NRCS), the Anderson County Soil and Water Conservation Services, and the South Carolina Department of Natural Resources. Clemson Extension Service offers a 'Farm-A-Syst' package to farmers. Farm-A-Syst allows the farmer to evaluate practices on their property and determine the nonpoint source impact they may be having. It recommends best management practices (BMPs) to correct nonpoint source problems on the farm. NRCS can provide cost share money to land owners installing BMPs.

SCDHEC is empowered under the State Pollution Control Act to perform investigations of and pursue enforcement for activities and conditions which threaten the quality of waters of the state.

The iterative BMP approach as defined in the general storm water NPDES MS4 permit is expected to provide significant implementation of this TMDL. Discovery and removal of illicit storm drain cross connection is one important element of the storm water NPDES permit. Public nonpoint source pollution education is another.

In addition, other interested parties (universities, local watershed groups, etc.) may apply for section 319 grants to install BMPs that will reduce fecal coliform loading to Rocky River and Wilson Creek. TMDL implementation projects are given highest priority for 319 funding.

In addition to the resources cited above for the implementation of this TMDL in the Rocky River watershed, Clemson Extension has developed a Home-A-Syst handbook that can help urban or rural homeowners reduce sources of NPS pollution on their property. This document guides homeowners through a self-assessment, including information on proper maintenance practices for septic tanks. SCDHEC also employs a nonpoint source educator who can assist with distribution of these tools as well as provide additional BMP information.

Using existing authorities and mechanisms, these measures will be implemented in the Rocky River watershed in order to bring about the necessary reductions in fecal coliform bacteria loading to Rocky River and Wilson Creek. DHEC will continue to monitor, according to the basin monitoring schedule, the effectiveness of implementation measures and evaluate stream water quality as the implementation strategy progresses.

7.0 REFERENCES

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APPENDIX A Data

Table A-1 Percent of Watershed Area Aggregated by Land Use Class for Areas Draining to Streamflow and Water Quality Monitoring Stations used in the Development of TMDLs for the Rocky River Watershed and Wilson Creek

Monitoring Station ID	Water	Urban	Row Crop	Pasture	Forest	Barren
02154790	0.3%	2.1%	17.2%	12.4%	66.9%	1.0%
02156050	0.6%	11.7%	30.3%	4.6%	52.7%	0.1%
02187910	0.5%	12.4%	14.5%	24.3%	48.0%	0.3%
Basin	1.2%	6.6%	13.6%	21.8%	56.1%	0.7%
SV-031	0.7%	14.1%	13.3%	25.0%	46.9%	0.1%
SV-041	0.6%	14.2%	13.2%	23.7%	48.1%	0.1%
SV-043	0.2%	8.3%	7.0%	17.8%	62.6%	4.0%
SV-139	0.0%	48.2%	10.6%	10.9%	30.1%	0.1%
SV-140	0.1%	36.7%	10.5%	15.3%	37.3%	0.1%
SV-141	0.3%	9.6%	16.5%	25.1%	47.9%	0.7%
SV-347	0.1%	2.4%	14.6%	24.7%	57.6%	0.6%

Table A-2 Watershed Area in Square Miles Aggregated by Land Use Class for Areas Draining to Streamflow and Water Quality Monitoring Stations used in the Development of TMDLs for the Rocky River Watershed and Wilson Creek

Monitoring Station ID	Water	Urban	Row Crop	Pasture	Forest	Barren	Total
	($miles^2$)						
02154790	0.2	1.2	10	6.9	37	0.2	56
02156050	0	1.3	1.7	1	2.6	0	6.6
02187910	0.5	11	13	22	44	0.3	92
Basin	2.7	15	32	51	131	1.7	233
SV-031	0.3	7.4	6.9	13	24	0.1	52
SV-041	0.3	8.0	7.4	13	27	0.1	56
SV-043	0.0	0.5	0.5	1.2	4.1	0.3	6.5
SV-139	0.0	0.7	0.2	0.2	0.5	0.0	1.6
SV-140	0.0	0.9	0.3	0.4	0.9	0.0	2.5
SV-141	0.1	3.4	5.8	8.9	17	0.2	35
SV-347	0.0	0.7	4.3	7.3	17	0.2	30

Table A-3 Fecal Coliform Data Collected between 1990 and 2001 at Water Quality Monitoring Stations in the Rocky River Watershed and Wilson Creek

SV-031	
Date	Value
1/18/1990	10
2/15/1990	132
3/8/1990	950
4/19/1990	112
5/30/1990	200
6/19/1990	450
7/23/1990	1300
8/9/1990	220
9/14/1990	2300
10/11/1990	390
11/1/1990	95
12/13/1990	170
1/10/1991	120
2/4/1991	88
3/6/1991	200
4/12/1991	460
5/9/1991	420
6/20/1991	1100
7/11/1991	210
8/8/1991	210
9/25/1991	9500
10/16/1991	470
11/8/1991	150
12/6/1991	160
1/7/1992	120
2/20/1992	30
3/5/1992	74
4/9/1992	62
5/11/1992	110
6/15/1992	230
7/22/1992	160
9/21/1992	370
10/26/1992	110
11/9/1992	80
12/2/1992	120
1/6/1993	440
3/1/1993	25
3/23/1993	370
4/8/1993	80
5/17/1993	180
6/16/1993	3200
7/20/1993	900
8/4/1993	340
9/15/1993	230
10/28/1993	100
11/4/1993	160
12/2/1993	68
1/19/1994	66
2/3/1994	45
3/24/1994	100
4/6/1994	520
5/26/1994	220
6/16/1994	2900
7/18/1994	220
8/24/1994	430
10/6/1994	280
10/14/1994	460
11/21/1994	700
12/2/1994	80
1/20/1995	63
2/14/1995	50
3/9/1995	600
4/24/1995	270
5/16/1995	360
6/2/1995	1500
7/27/1995	18000
8/3/1995	700
9/6/1995	200
10/6/1995	1200
11/13/1995	460
12/4/1995	68
1/4/1996	64
2/6/1996	120
3/29/1996	180
4/29/1996	140
5/31/1996	140
6/28/1996	230
7/26/1996	1200
8/9/1996	580
9/18/1996	580
10/29/1996	310
11/7/1996	260
12/3/1996	300
1/23/1997	120
2/19/1997	7
3/20/1997	140
4/2/1997	55
5/23/1997	420
6/25/1997	1000
7/7/1997	240
8/7/1997	590
9/26/1997	2000
10/17/1997	250
11/6/1997	270
12/30/1997	230
01/29/98	110
03/04/98	120
04/02/98	220
05/06/98	190
06/16/98	1400
07/21/98	320
08/14/98	2800
09/17/98	280
10/26/98	260
11/23/98	410
12/09/98	1500
12/29/1999	150
11/10/1999	870
10/12/1999	1500
9/1/1999	200
8/18/1999	300
7/20/1999	380
6/15/1999	540
5/12/1999	430
4/26/1999	240
3/31/1999	150
2/16/1999	260
1/20/1999	140
8/25/2000	350
7/27/2000	280
6/29/2000	*Present >QL
5/9/2000	330
4/11/2000	140
3/16/2000	300
2/28/2000	480
1/20/2000	180
9/13/2000	240
12/20/2000	68
10/3/2000	300

Table A-3 (Continued)

SV-041	
Date	Value
5/30/1990	40
6/19/1990	38
7/23/1990	30
8/9/1990	64
9/14/1990	500
10/11/1990	20000
5/9/1991	15000
6/20/1991	140
7/11/1991	270
8/8/1991	180
9/25/1991	3900
10/16/1991	130
5/17/1993	160
6/16/1993	4200
7/20/1993	240
8/4/1993	250
9/15/1993	160
10/28/1993	68
5/26/1994	130
6/16/1994	2800
8/24/1994	660
10/6/1994	250
10/14/1994	390
5/16/1995	260
6/2/1995	1700
7/27/1995	19000
8/3/1995	180
9/6/1995	350
10/6/1995	2800
11/13/1995	320
12/4/1995	140
1/4/1996	18
2/6/1996	130
3/29/1996	220
4/29/1996	140
5/31/1996	135

SV-041	
Date	Value
6/28/1996	100
7/26/1996	2100
8/9/1996	300
9/19/1996	460
10/29/1996	100
5/23/1997	300
6/25/1997	160
7/7/1997	100
8/7/1997	280
9/26/1997	2400
10/17/1997	130
06/16/98	2000
07/21/98	120
08/14/98	3500
09/17/98	240
10/26/98	180
12/29/1999	150
11/10/1999	150
10/12/1999	2700
9/1/1999	180
8/18/1999	140
7/20/1999	240
6/15/1999	280
5/12/1999	240
12/20/2000	140
10/3/2000	260
9/13/2000	330
8/25/2000	780
7/27/2000	410
6/29/2000	*Present >QL
5/9/2000	170
4/11/2000	120
3/16/2000	720
2/28/2000	240
1/20/2000	370

Table A-3 (Continued)

SV-043	
Date	Value
5/1/1990	380
6/4/1990	200
7/5/1990	310
8/2/1990	190
9/12/1990	210
10/12/1990	7000
5/17/1991	170
6/6/1991	200
7/22/1991	85
8/8/1991	130
9/26/1991	2000
5/14/1993	270
6/17/1993	200
7/28/1993	420
8/27/1993	120
9/14/1993	130
10/6/1993	140
5/12/1994	130
6/22/1994	200
7/5/1994	710
8/11/1994	180
9/22/1994	110
5/17/1995	260
6/29/1995	380
7/14/1995	380
8/18/1995	290
9/8/1995	100
10/3/1995	220

SV-043	
Date	Value
5/10/1996	540
6/19/1996	450
7/22/1996	520
8/15/1996	310
9/27/1996	280
10/7/1996	250
5/9/1997	260
6/6/1997	410
7/2/1997	420
8/28/1997	1300
9/19/1997	160
10/17/1997	260
05/14/98	260
06/18/98	280
08/20/98	280
10/19/98	290
10/4/1999	17000
9/13/1999	1000
8/25/1999	9500
7/29/1999	190
6/17/1999	1000
5/11/1999	230
10/12/2000	390
9/26/2000	580
8/15/2000	90
7/31/2000	360
6/1/2000	810
5/9/2000	280

Table A-3 (Continued)

SV-139	
Date	Value
5/30/1990	330
6/19/1990	1000
7/23/1990	620
8/9/1990	500
9/14/1990	9200
10/11/1990	140000
5/9/1991	1100
6/20/1991	58
7/11/1991	30000
8/8/1991	160000
9/25/1991	83000
10/16/1991	2200
5/17/1993	15000
6/16/1993	1600
7/20/1993	2500
8/4/1993	68000
9/15/1993	100
10/28/1993	1200000
5/26/1994	2500
6/16/1994	2300
7/18/1994	1500
8/24/1994	1600
10/6/1994	940
5/16/1995	3500
6/2/1995	35000
7/27/1995	24000
8/3/1995	600
9/6/1995	1000000
10/6/1995	2200

SV-139	
Date	Value
5/31/1996	830
6/28/1996	2700
7/26/1996	22000
8/9/1996	96
9/19/1996	440
10/29/1996	180
5/9/1997	200
6/6/1997	460
7/2/1997	4800
8/28/1997	380
9/19/1997	180
10/17/1997	60
05/14/98	480
06/18/98	1100
08/20/98	1800
10/19/98	100
10/4/1999	21000
9/13/1999	5000
8/25/1999	5300
7/29/1999	100
6/17/1999	3800
5/11/1999	860
10/12/2000	290
9/26/2000	380
8/15/2000	60
7/31/2000	220
6/1/2000	320
5/9/2000	1300

Table A-3 (Continued)

SV-140	
Date	Value
5/30/1990	260
6/19/1990	500
7/23/1990	440
8/9/1990	280
9/14/1990	600
10/11/1990	460
5/9/1991	240
6/20/1991	660
7/11/1991	170
8/8/1991	300
9/25/1991	9100
10/16/1991	130
5/17/1993	820
6/16/1993	1100
7/20/1993	420
8/4/1993	960
9/15/1993	300
10/28/1993	240
5/26/1994	260
6/16/1994	420
7/18/1994	200
8/24/1994	880
10/6/1994	860
10/14/1994	4900
5/16/1995	380
6/2/1995	2800
7/27/1995	6000
8/3/1995	1900
9/6/1995	7600

SV-140	
Date	Value
10/6/1995	6000
5/31/1996	780
6/28/1996	720
7/26/1996	3900
8/9/1996	1100
9/19/1996	260
10/29/1996	3600
5/9/1997	420
6/6/1997	580
7/2/1997	340
8/28/1997	460
9/19/1997	580
10/17/1997	440
05/14/98	280
06/18/98	1000
08/20/98	500
10/19/98	540
10/4/1999	14000
9/13/1999	1300
8/25/1999	320
7/29/1999	240
6/17/1999	180
5/11/1999	220
10/12/2000	280
9/26/2000	370
8/15/2000	60
7/31/2000	700
6/1/2000	60
5/9/2000	420

Table A-3 (Continued)

SV-141	
Date	Value
5/30/1990	380
6/19/1990	240
7/23/1990	900
8/9/1990	400
9/14/1990	450
10/11/1990	620
5/9/1991	280
6/20/1991	1600
7/11/1991	250
8/8/1991	240
9/25/1991	12000
10/16/1991	360
5/17/1993	590
6/16/1993	210
7/20/1993	220
8/4/1993	340
9/15/1993	470
10/28/1993	160
5/26/1994	560
6/16/1994	2600
7/18/1994	200
8/24/1994	400
10/6/1994	330
10/14/1994	440
5/16/1995	350
6/2/1995	460
7/27/1995	8100
8/3/1995	530
9/6/1995	330
10/6/1995	3600

SV-141	
Date	Value
5/31/1996	310
6/28/1996	240
7/26/1996	2000
8/9/1996	420
9/19/1996	780
10/29/1996	80
5/23/1997	240
6/6/1997	330
7/7/1997	240
8/7/1997	63
9/26/1997	2000
10/17/1997	160
05/06/98	660
06/16/98	200
07/21/98	160
08/14/98	3700
09/17/98	430
10/26/98	130
10/12/1999	860
9/1/1999	200
8/18/1999	87
7/20/1999	260
6/15/1999	140
5/12/1999	290
10/3/2000	290
9/13/2000	230
8/25/2000	320
7/27/2000	400
6/29/2000	300
5/9/2000	130

Table A-3 (Continued)

SV-347	
Date	Value
11/20/1995	210
12/15/1995	190
1/4/1996	140
2/10/1996	240
3/15/1996	420
4/5/1996	90
5/10/1996	710
6/19/1996	380
7/22/1996	200
8/15/1996	290
9/27/1996	440
10/7/1996	300
12/2/1999	420
11/8/1999	110
6/7/2000	230
5/17/2000	110
4/12/2000	260
3/7/2000	390
2/3/2000	680
1/6/2000	340
12/20/2000	220
11/8/2000	59
10/26/2000	120
9/18/2000	200
8/24/2000	120
7/5/2000	140
3/12/2001	420
1/25/2001	320
7/5/2001	740
6/8/2001	150
4/9/2001	330
12/6/2001	290
11/15/2001	110
10/17/2001	230

APPENDIX B Calculations

Table B-1 TMDL Loads

Station	SV-031
Instantaneous Conc. (#/100 ml)	380
Geo. Mean Conc. (#/100 ml)	190

Mean	5.39E+11
Allowable Load (#/day)	5.39E+11
Geometric Mean Load (#/30days)	8.08E+12

Percent Exceedance (%)	Load(#/Day)
10	1.26E+12
15	1.01E+12
20	8.61E+11
25	7.45E+11
30	6.66E+11
35	5.92E+11
40	5.34E+11
45	4.86E+11
50	4.49E+11
55	4.17E+11
60	3.91E+11
65	3.65E+11
70	3.33E+11
75	3.06E+11
80	2.80E+11
85	2.48E+11
90	2.11E+11

Station	SV-041
Instantaneous Conc. (#/100 ml)	380
Geo. Mean Conc. (#/100 ml)	190

Mean	5.82E+11
Allowable Load (#/day)	5.82E+11
Geometric Mean Load (#/30days)	8.73E+12

Percent Exceedance (%)	Load(#/Day)
10	1.36E+12
15	1.10E+12
20	9.31E+11
25	8.05E+11
30	7.20E+11
35	6.40E+11
40	5.77E+11
45	5.26E+11
50	4.86E+11
55	4.51E+11
60	4.23E+11
65	3.94E+11
70	3.60E+11
75	3.31E+11
80	3.03E+11
85	2.68E+11
90	2.28E+11

Station	SV-043
Instantaneous Conc. (#/100 ml)	380
Geo. Mean Conc. (#/100 ml)	190

Mean	8.26E+10
Allowable Load (#/day)	8.26E+10
Geometric Mean Load (#/30days)	1.24E+12

Percent Exceedance (%)	Load(#/Day)
10	1.68E+11
15	1.41E+11
20	1.23E+11
25	1.10E+11
30	1.01E+11
35	9.30E+10
40	8.53E+10
45	7.99E+10
50	7.44E+10
55	6.89E+10
60	6.45E+10
65	6.02E+10
70	5.69E+10
75	5.25E+10
80	4.70E+10
85	4.16E+10
90	3.72E+10

Table B-1 (Continued)

Station	SV-139
Instantaneous Conc. (#/100 ml)	**380**
Geo. Mean Conc. (#/100 ml)	**190**

Mean	1.62E+10
Allowable Load (#/day)	1.62E+10
Geometric Mean Load (#/30days)	2.43E+11

Percent Exceedance (%)	Load(#/Day)
10	3.13E+10
15	2.68E+10
20	2.24E+10
25	2.10E+10
30	1.97E+10
35	1.83E+10
40	1.72E+10
45	1.63E+10
50	1.52E+10
55	1.43E+10
60	1.34E+10
65	1.25E+10
70	1.14E+10
75	1.03E+10
80	9.39E+09
85	8.49E+09
90	7.60E+09

Station	SV-140
Instantaneous Conc. (#/100 ml)	**380**
Geo. Mean Conc. (#/100 ml)	**190**

Mean	2.65E+10
Allowable Load (#/day)	2.65E+10
Geometric Mean Load (#/30days)	3.97E+11

Percent Exceedance (%)	Load(#/Day)
10	5.11E+10
15	4.38E+10
20	3.65E+10
25	3.43E+10
30	3.21E+10
35	2.99E+10
40	2.81E+10
45	2.66E+10
50	2.48E+10
55	2.33E+10
60	2.19E+10
65	2.04E+10
70	1.86E+10
75	1.68E+10
80	1.53E+10
85	1.39E+10
90	1.24E+10

Station	SV-141
Instantaneous Conc. (#/100 ml)	**380**
Geo. Mean Conc. (#/100 ml)	**190**

Mean	3.65E+11
Allowable Load (#/day)	3.65E+11
Geometric Mean Load (#/30days)	5.48E+12

Percent Exceedance (%)	Load(#/Day)
10	8.53E+11
15	6.88E+11
20	5.84E+11
25	5.05E+11
30	4.52E+11
35	4.02E+11
40	3.62E+11
45	3.30E+11
50	3.05E+11
55	2.83E+11
60	2.65E+11
65	2.47E+11
70	2.26E+11
75	2.08E+11
80	1.90E+11
85	1.68E+11
90	1.43E+11

Table B-1 (Continued)

Station	SV-347
Instantaneous Conc. (#/100 ml)	**380**
Geo. Mean Conc. (#/100 ml)	**190**

Mean	3.75E+11
Allowable Load (#/day)	3.75E+11
Geometric Mean Load (#/30days)	5.62E+12

Percent Exceedance (%)	Load(#/Day)
10	7.64E+11
15	6.40E+11
20	5.55E+11
25	5.01E+11
30	4.56E+11
35	4.21E+11
40	3.87E+11
45	3.62E+11
50	3.37E+11
55	3.12E+11
60	2.93E+11
65	2.73E+11
70	2.58E+11
75	2.38E+11
80	2.13E+11
85	1.88E+11
90	1.69E+11

Table B-2 Existing Loads

	Station	SV-031
Trend Line:		Power
Equation: y=1E+13*x^(-0.6139)		

Existing Load (#/Day):	1.08E+12
Average (#/Day):	1.08E+12

Percent Exceedance(%)	Load(#/Day)
10	2.43E+12
15	1.90E+12
20	1.59E+12
25	1.39E+12
30	1.24E+12
35	1.13E+12
40	1.04E+12
45	9.66E+11
50	9.06E+11
55	8.54E+11
60	8.10E+11
65	7.71E+11
70	7.37E+11
75	7.06E+11
80	6.79E+11
85	6.54E+11
90	6.31E+11

	Station	SV-041
Trend Line:		Power
Equation: y=5E+13*x^(-0.7517)		

Existing Load (#/Day):	3.37E+12
Average (#/Day):	3.37E+12

Percent Exceedance(%)	Load(#/Day)
10	8.86E+12
15	6.53E+12
20	5.26E+12
25	4.45E+12
30	3.88E+12
35	3.45E+12
40	3.12E+12
45	2.86E+12
50	2.64E+12
55	2.46E+12
60	2.30E+12
65	2.17E+12
70	2.05E+12
75	1.95E+12
80	1.86E+12
85	1.77E+12
90	1.70E+12

	Station	SV-043
Trend Line:		Power
Equation: y=2E+13*x^(-1.1583)		

Existing Load (#/Day):	3.51E+11
Average (#/Day):	3.51E+11

Percent Exceedance(%)	Load(#/Day)
10	1.39E+12
15	8.68E+11
20	6.22E+11
25	4.81E+11
30	3.89E+11
35	3.25E+11
40	2.79E+11
45	2.43E+11
50	2.15E+11
55	1.93E+11
60	1.74E+11
65	1.59E+11
70	1.46E+11
75	1.35E+11
80	1.25E+11
85	1.16E+11
90	1.09E+11

Table B-2 (Continued)

Station	SV-139
Trend Line:	**Power**
Equation: y=5E+12*x^(-0.8769)	

Existing Load (#/Day):	**2.21E+11**
Average (#/Day):	**2.21E+11**

Percent Exceedance(%)	Load(#/Day)
10	6.64E+11
15	4.65E+11
20	3.61E+11
25	2.97E+11
30	2.53E+11
35	2.21E+11
40	1.97E+11
45	1.78E+11
50	1.62E+11
55	1.49E+11
60	1.38E+11
65	1.29E+11
70	1.21E+11
75	1.13E+11
80	1.07E+11
85	1.02E+11
90	9.67E+10

Station	SV-140
Trend Line:	**Power**
Equation: y=1E+13*x^(-1.3309)	

Existing Load (#/Day):	**1.02E+11**
Average (#/Day):	**1.02E+11**

Percent Exceedance(%)	Load(#/Day)
10	4.67E+11
15	2.72E+11
20	1.86E+11
25	1.38E+11
30	1.08E+11
35	8.81E+10
40	7.38E+10
45	6.31E+10
50	5.48E+10
55	4.83E+10
60	4.30E+10
65	3.87E+10
70	3.50E+10
75	3.20E+10
80	2.93E+10
85	2.70E+10
90	2.51E+10

Station	SV-141
Trend Line:	**Power**
Equation: y=2E+13*x^(-0.9001)	

Existing Load (#/Day):	**8.17E+11**
Average (#/Day):	**8.17E+11**

Percent Exceedance(%)	Load(#/Day)
10	2.52E+12
15	1.75E+12
20	1.35E+12
25	1.10E+12
30	9.36E+11
35	8.15E+11
40	7.23E+11
45	6.50E+11
50	5.91E+11
55	5.43E+11
60	5.02E+11
65	4.67E+11
70	4.37E+11
75	4.10E+11
80	3.87E+11
85	3.67E+11
90	3.48E+11

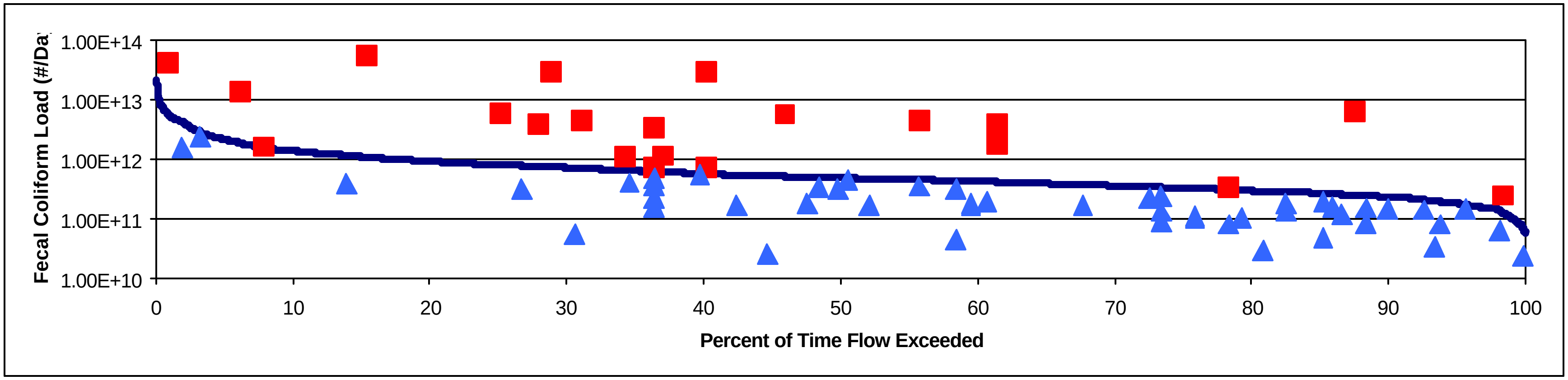
Table B-2 (Continued)

Station	**SV-347**
Trend Line:	**Power**
Equation: y=5E+12*x^(-0.6497)	

Existing Load (#/Day):	**4.79E+11**
Average (#/Day):	**4.79E+11**

Percent Exceedance(%)	Load(#/Day)
10	1.12E+12
15	8.61E+11
20	7.14E+11
25	6.18E+11
30	5.49E+11
35	4.96E+11
40	4.55E+11
45	4.22E+11
50	3.94E+11
55	3.70E+11
60	3.50E+11
65	3.32E+11
70	3.16E+11
75	3.03E+11
80	2.90E+11
85	2.79E+11
90	2.69E+11

Figure B-1 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at SV-041



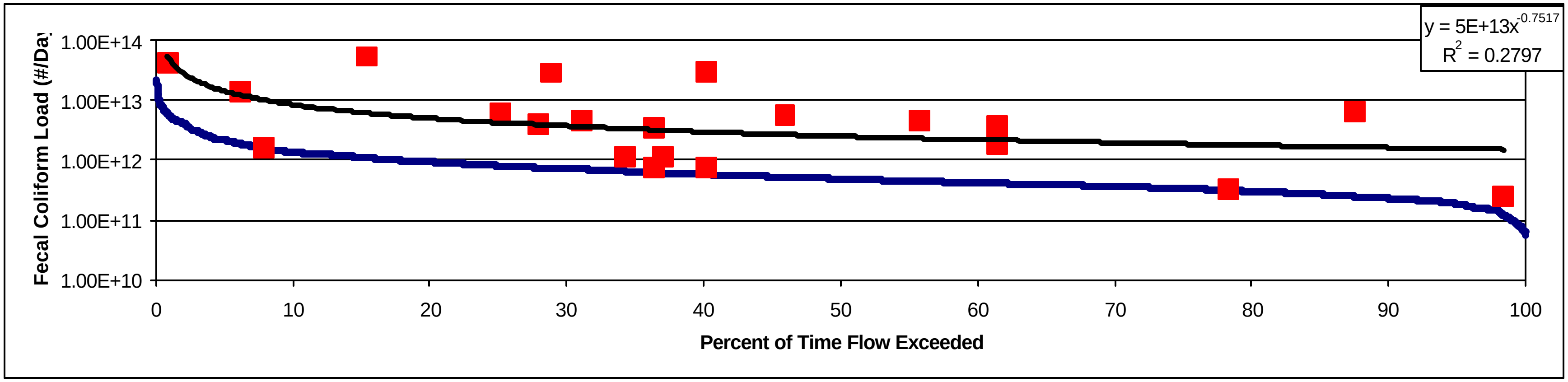
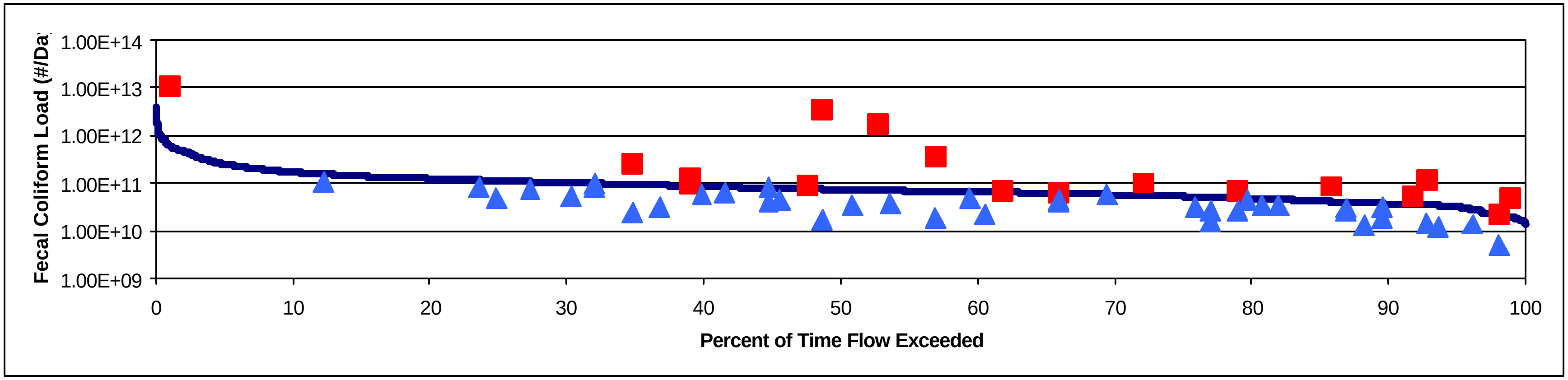


Figure B-2 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at SV-043



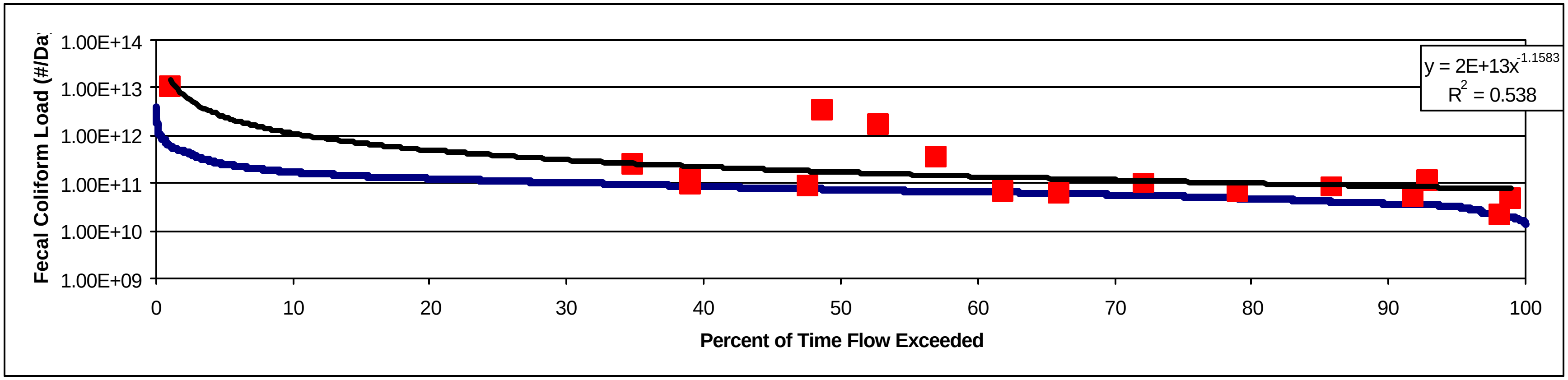
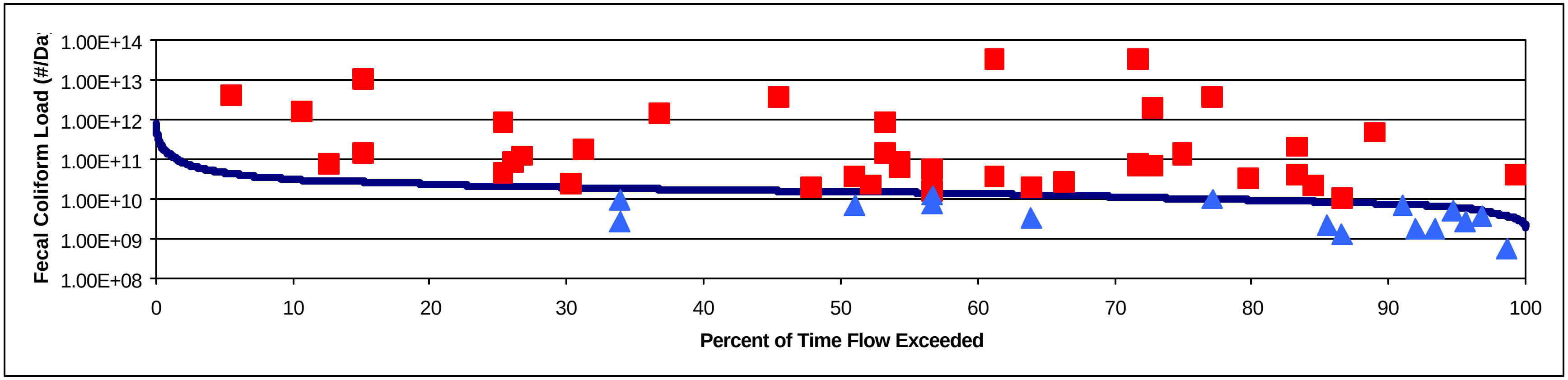


Figure B-3 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at SV-139



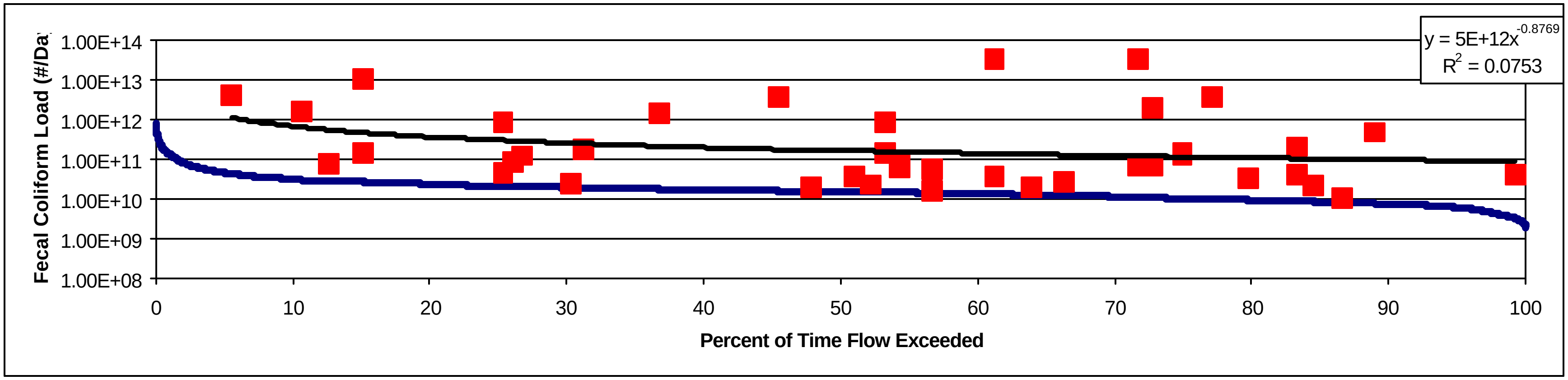
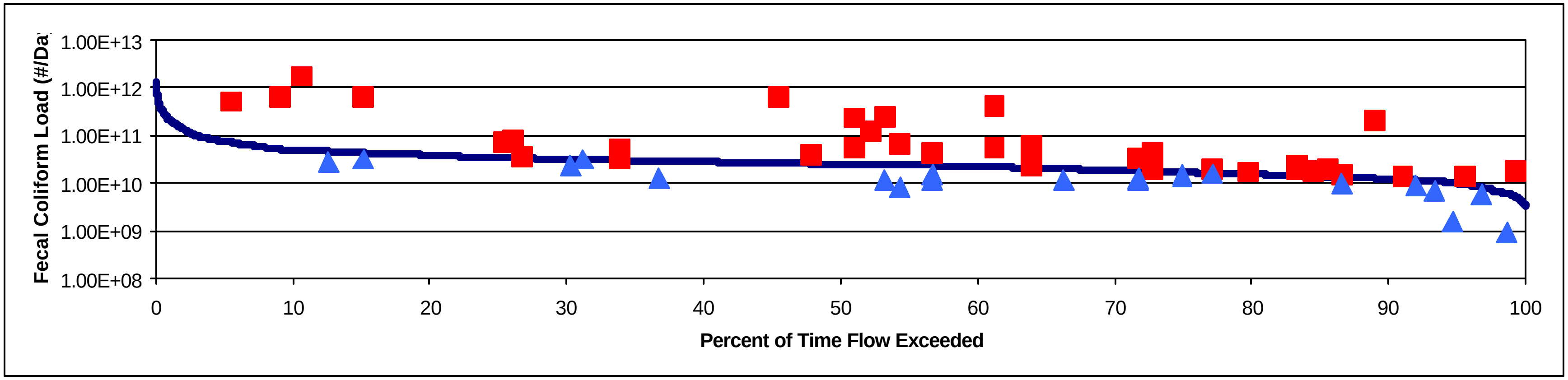


Figure B-4 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at SV-140



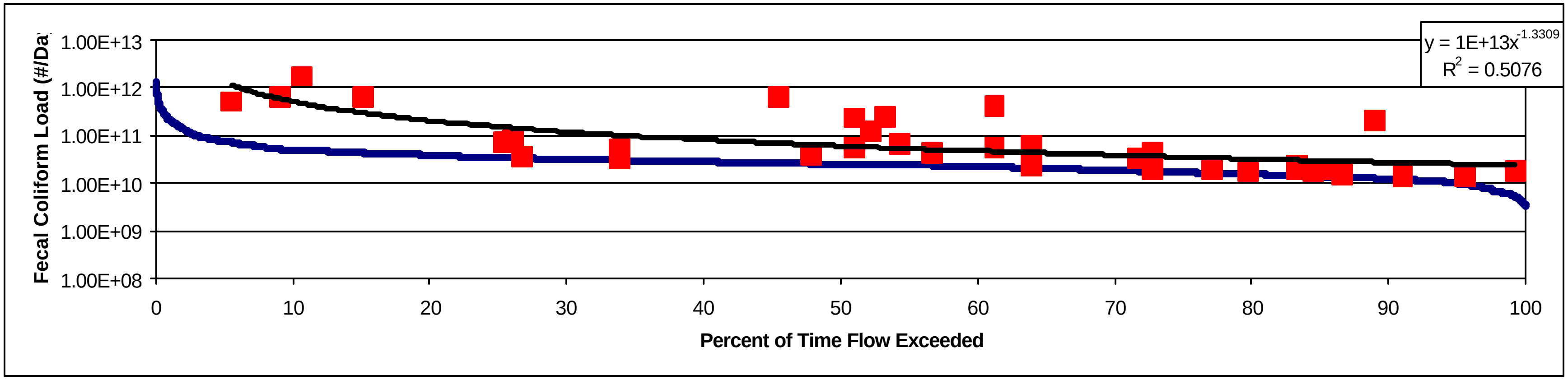
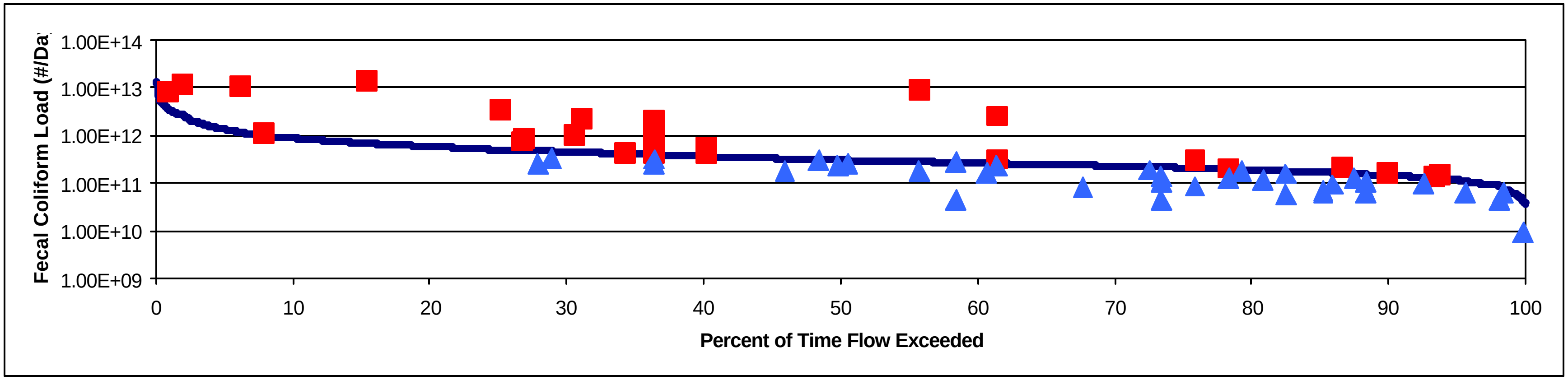


Figure B-5 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at SV-141



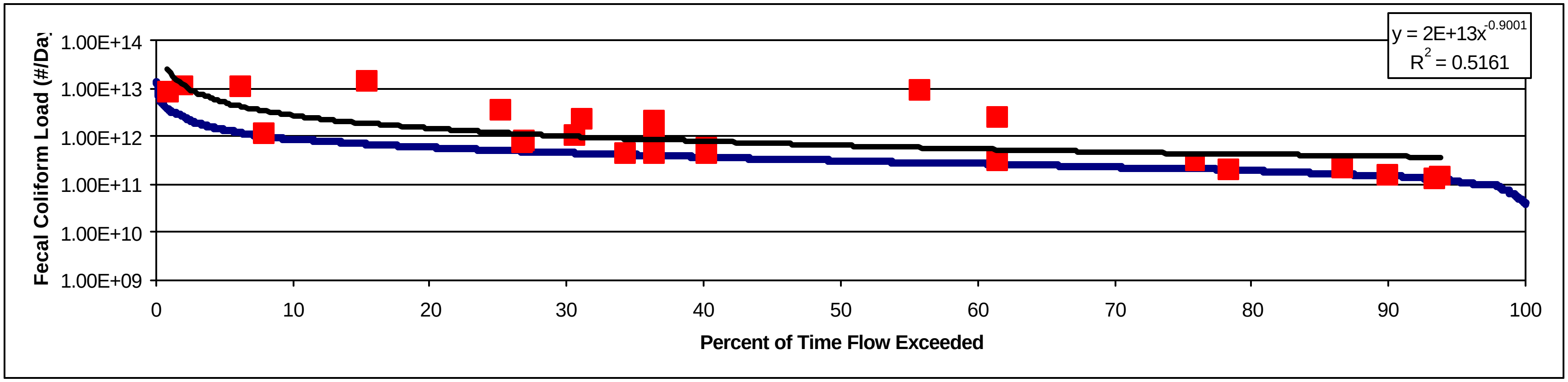
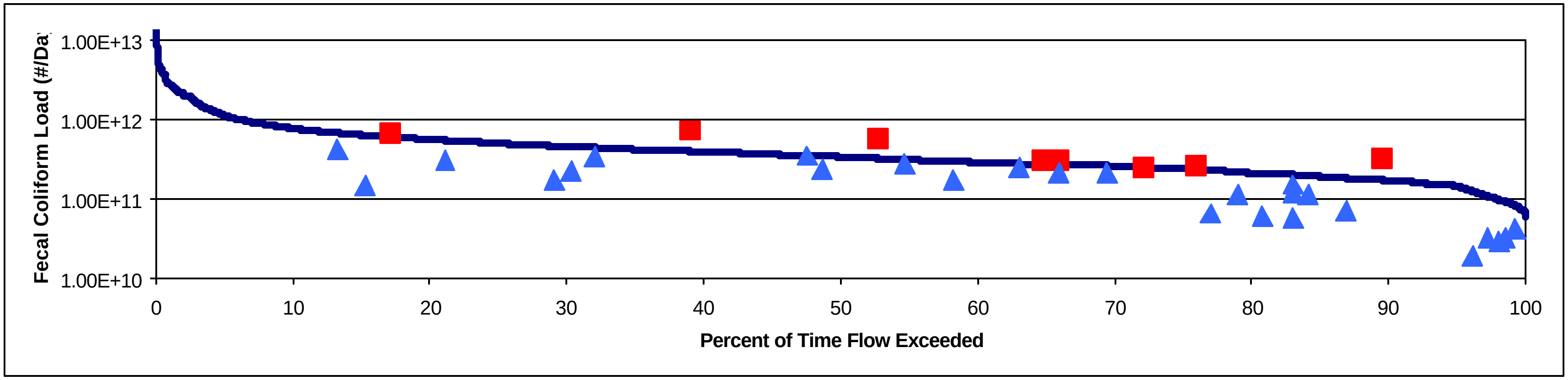


Figure B-6 Load Duration Curve with All Measured Data and Power Trend Line Generated from Violating Fecal Coliform Bacteria Measured at SV-347



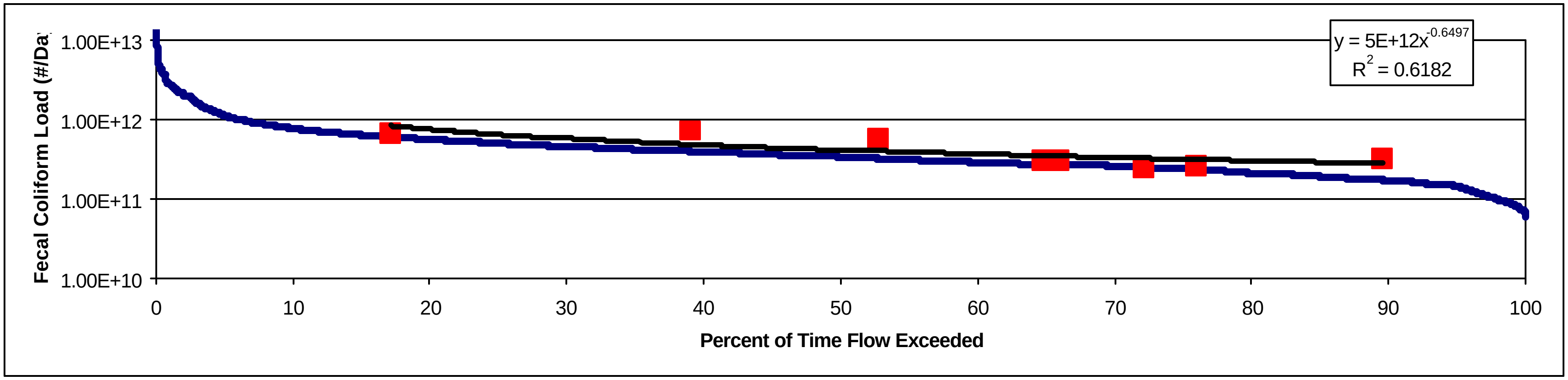
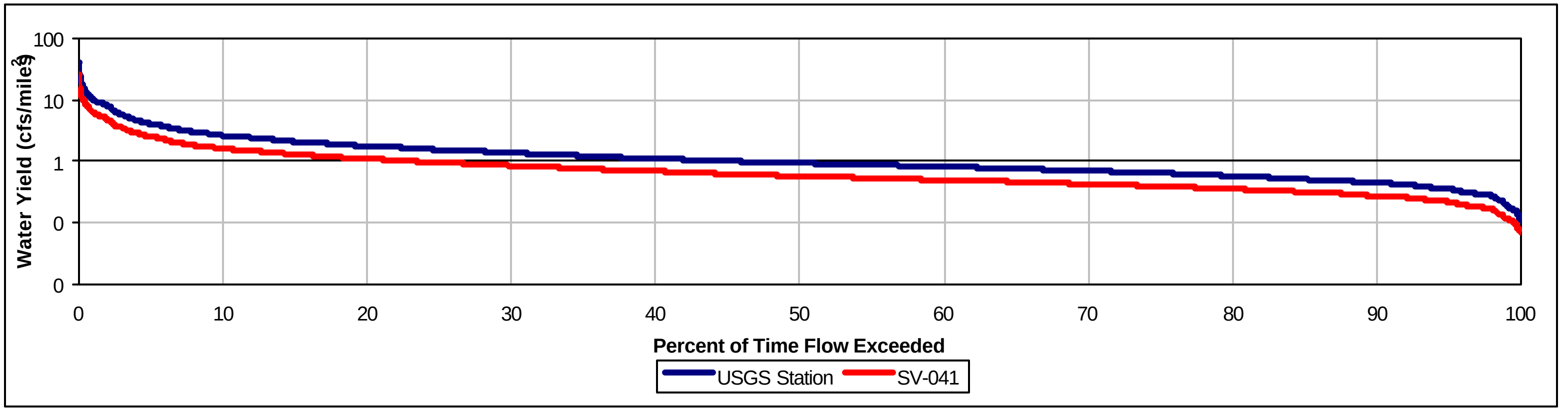


Figure B-7 Water Yield (cubic feet per second per square mile) Based on Measured Daily Streamflow from USGS station 02187910



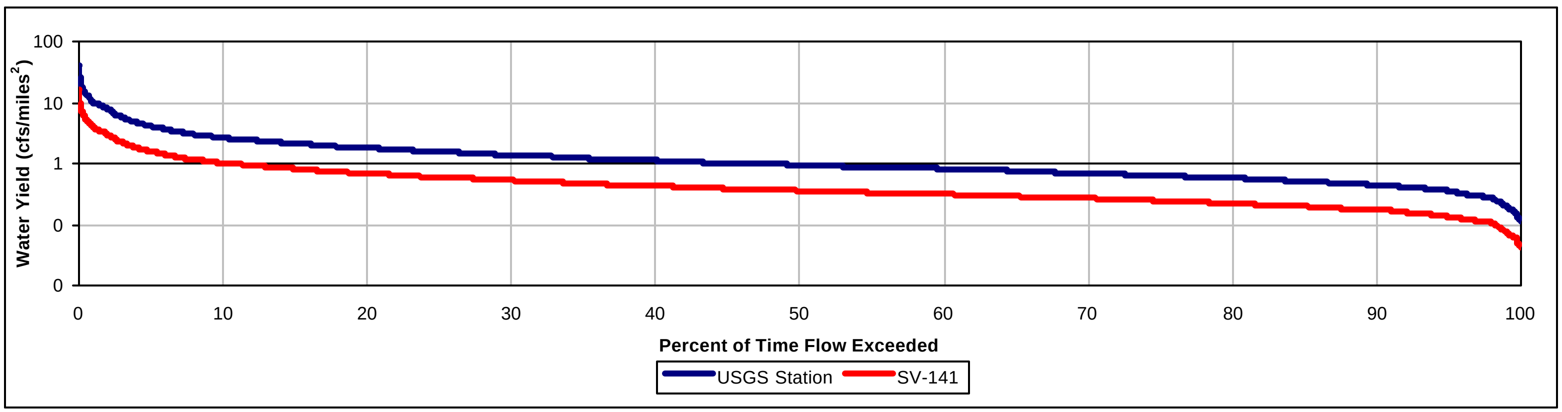
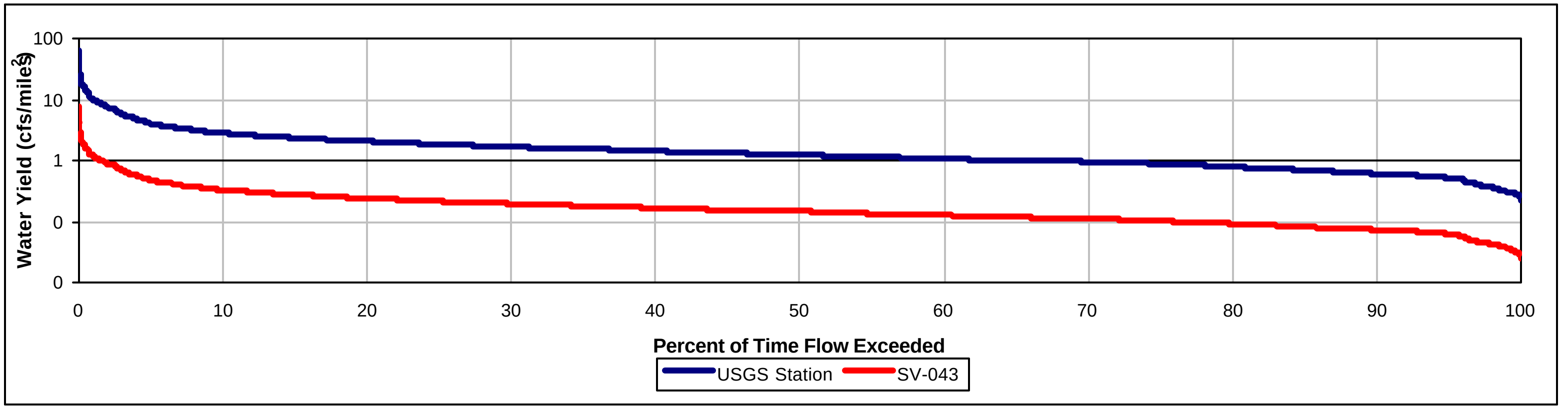


Figure B-8 Water Yield (cubic feet per second per square mile) Based on Measured Daily Streamflow from USGS station 02154790



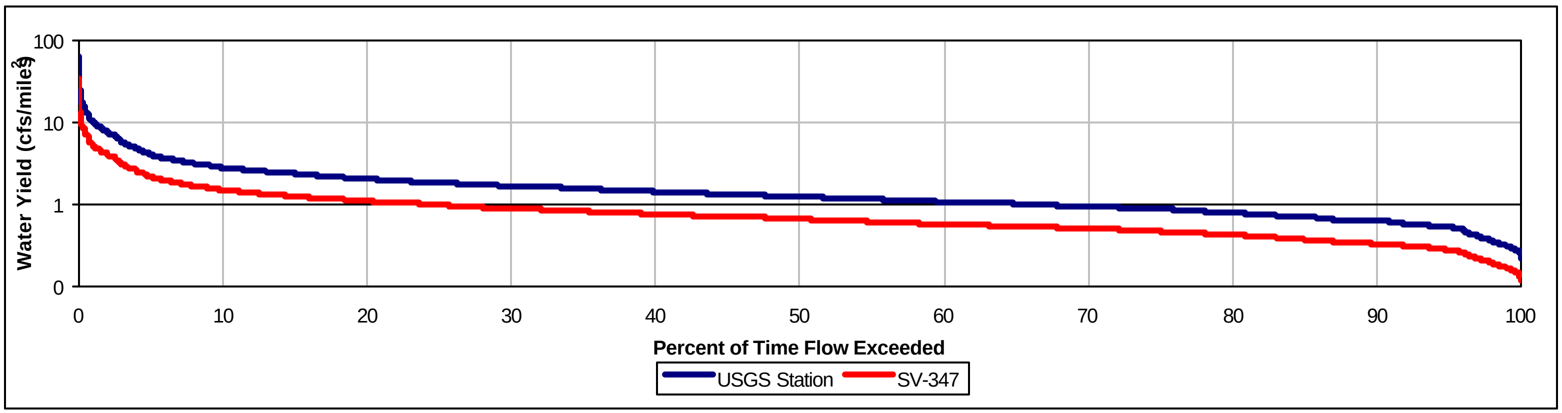
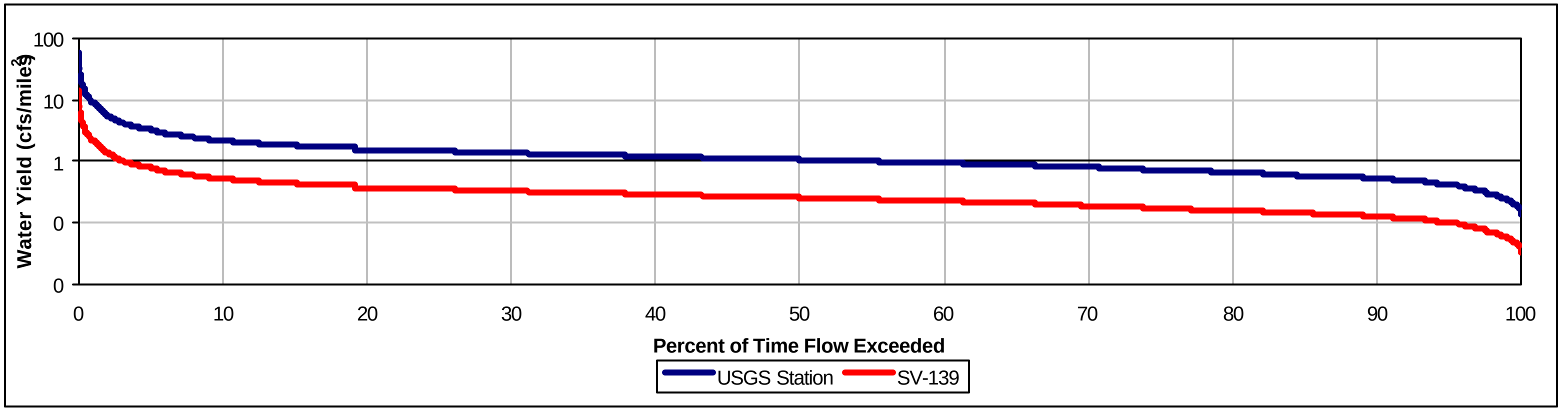
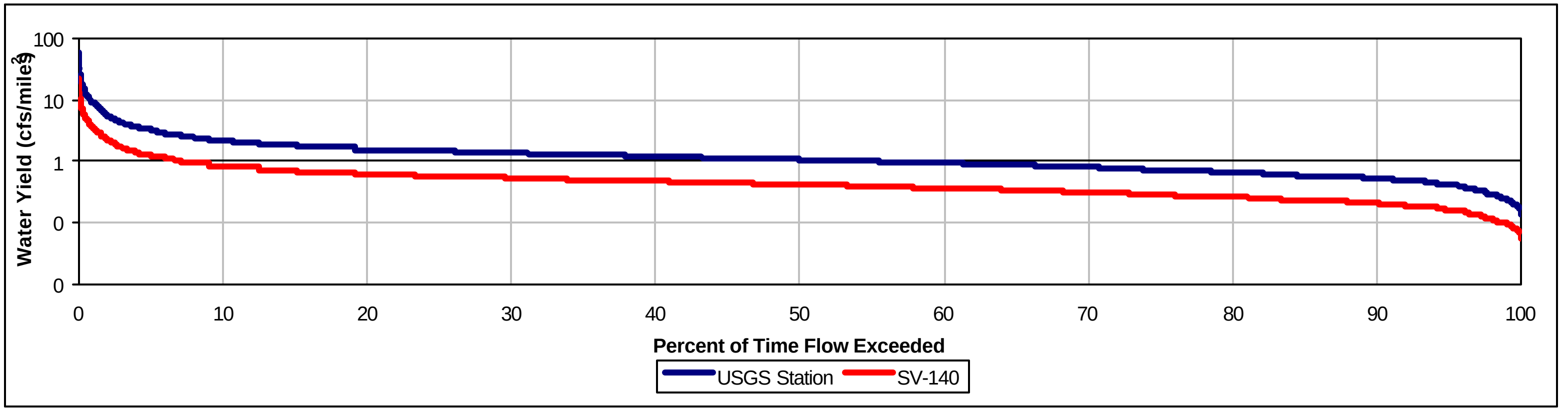


Figure B-9 Water Yield (cubic feet per second per square mile) Based on Measured Daily Streamflow from USGS station 02156050





APPENDIX C Public Notification